of TPS. The collimator angle was changed from 0 to 170 degree, the leaf-speed was changed from 2.0 to 4.0 cm/sec. Then these plans were delivered to phantom and verified with three-dimensional detector: Delta4 (ScandiDos). All plans were delivered with a Varian Clinac 21EX linear accelerator equipped with Millenium multi-leaf collimator (MLC). The MLC motion logs during VMAT delivery were acquired and analyzed. The dose distributions were evaluated if those plans were acceptable for RTOG0615 dose tolerance or not.
Results: As results of the plan comparison with several collimator angle settings, a single arc plan with collimator angle of 45 degree was acceptable for RTOG0615. On the other hand, all double arc plans were acceptable for RTOG0615. As results of the dosimetric verification by use of Delta4 detector, the passing rate of gamma analysis for the double arc plan with collimator angle 15/345 degree was worst in all plans. As results of comparison with various leaf-speeds, the passing rates of gamma analysis were worse in plans with leaf-speed of more than 3.5 cm/sec.

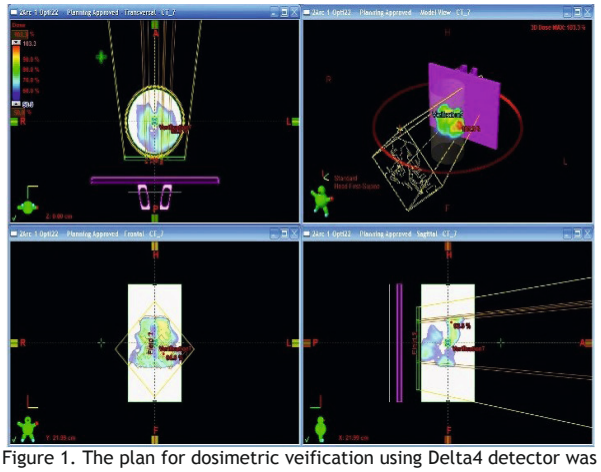


Figure 1. The plan for dosimetric veification using Delta4 detector was created by Varian Eclipse TPS.
Conclusions: The number of arc and maximum leaf-speed were affective factors for accurate dose delivery in VMAT plans. On the other hand, the setting of collimator angle was less affective parameter than those factors.

EP-1205
Feasibility of using the novel Vero SBRT system for intracranial SRS
M. Buleteanu[1], D. Verellen[1], T. Gevaert[1], T. Depuydt[1], K. Poels[1], V. Simon[2], M. de Ridder[1]
[1]*UZ Brussel, Radiotherapy Department, Brussels, Belgium*
[2]*Babes Bolyai University, Department of Physics, Cluj Napoca, Romania*

Purpose/Objective: The feasibility of using the Vero system for radiosurgery is yet unexplored. The high mechanical stability of the machine, the non-coplanar O-ring rotation liberty and the volumetric on-board imaging capabilities imply its use for intracranial stereotactic treatments. The Vero SBRT system was benchmarked in a planning study against a Novalis SRS system for quality of delivered dose distributions to intracranial lesions.
Materials and Methods: A total of 27 patients with one single brain lesion treated on the BrainLAB Novalis system, with 3mm leaf width MLC and C-arm gantry, were re-planned for BrainLAB Vero, with a 5mm leaf width MLC mounted on an O-ring gantry allowing rotations around both the horizontal and vertical axis. The Novalis dynamic conformal arc (DCA) planning included vertex arcs, using 90° couch rotation. These vertex arcs cannot be reproduced with Vero due to the mechanical limitations of the O-ring gantry. Alternative class solutions were investigated for the Vero (Figure 1). Additionally, to distinguish between the effect of MLC leaf width and different beam arrangements on dose distributions, the Vero class solutions were also applied for Novalis. The added value of IMRT was also investigated in this study. Quality of the achieved dose distributions was expressed in the conformity index (CI) and gradient index (GI), and compared using a paired Student t-test with statistical significance for p-values ≤ 0.05.

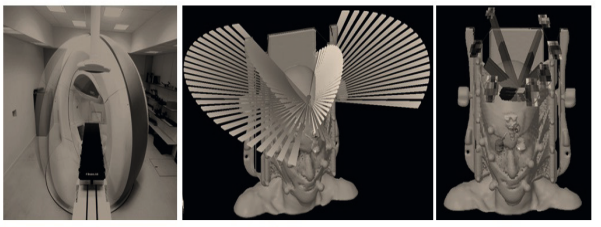


Figure 1. Treatment planning approaches used with the Vero system for SRS

Results: For the larger lesions, volumes > 5cm3 no statistical significant difference in conformity was observed between Vero and Novalis. For smaller lesions, the dose distributions showed a significantly better conformity for the Novalis (ΔCI=13.74%, p=0.0002) mainly due to the smaller MLC leaf width. IMRT on Vero reduces this conformity difference to non-significant levels compared to Novalis. The cut-off for realizing a GI of 3, characterizing a sharp dose fall-off outside the target volume was achieved for 4cm^3 on Novalis and for 7cm^3 with the Vero using DCA technique. Using non-coplanar IMRT, this threshold was reduced to 3cm^3 for the Vero system.
Conclusions: The smaller MLC and the presence of the vertex fields allow the Novalis system to better conform the dose around the lesion and to obtain steeper dose fall-off outside the lesion. However, comparable dose dosimetric characteristics can be achieved on Vero for lesions larger then 3cm^3 and using IMRT.

EP-1206
Step-and-Shoot IMRT segmentation method - impact on QA and dose distribution
A.R. Figueira[1], A. Monteiro[1], A.L. Carvalho[1], T. Reis[1], V. Batel[1], L. Alves[1], P. Fontes[1], P. Meireles[1], G. Pinto[1]
[1]*Hospital de São João, Radiotherapy, Porto, Portugal*

Purpose/Objective: When Elekta CMS XiO TPS was improved (v.4.62) with an additional segmentation method for IMRT planning, Smart Sequencing (SS), we realized that the shape and delivery sequence of the segments produce by this method were considerably different from the ones produced with the other available method, Sliding-Window (SW). The purpose of this work was to study this new segmentation method by comparing the plans produced with this option (SS plans) to the one we had before (SW plans), for a group of selected prostate patients. We evaluated the impact both on the achieved dose distributions and QA results.
Materials and Methods: We selected a group of IMRT prostate patients and evaluated 2 typical situations in our department: patients treating only prostate and seminal vesicles (Type 1) and patients treating also pelvic nodes (Type 2). We used the CMS XiO (v.4.62) TPS to calculate alternative IMRT plans (SW vs. SS), both calculated using the same dose constraints for target volumes and organs at risk and distribution of fields. The plans were produced to be delivered in Siemens PRIMUS linear accelerator with 6 or 18 MV beams. The plans were compared analysing DVH for the target and organs at risks, according to ICRU 83 recommendations. The impact on IMRT QA was evaluated comparing point dose measurements, with an ion chamber, and plane dose distributions, using a 2D array. We compared measured vs. calculated dose to a point in the phantom, and gamma parameters such as *mean gamma value* and *gamma passing rate*.
Results: For Type 1 cases, we were able to produce plans with equivalent dose distributions to PTV and OARs using both segmentation methods but, for all cases, using de SS method resulted in plans with a reduced number of segments and MUs, and thus reduced delivery times. The QA results were considered equivalent and all patients were treated with the plans produced with the SS methods manly because of the reduced delivery time.
For Type 2 cases, although SS plans resulted in a reduced number of segments and MUs, the SW plans always resulted in better dose distributions, namely in terms of OARs sparing. All patients were treated with these plans. No significant differences were found in terms of IMRT QA.
Conclusions: When treating regular target volumes, such as most prostate tumours (Type 1), the use of *Smart Sequencing* (SS) segmentation method resulted in dose distributions equivalent or better than those achieved with the *Sliding Window* (SW) method, always with reduced number of segments and MU. The associated reduction in the delivery time will eventually allow us to treat more prostate patients with IMRT.

When treating more complex target volumes, like pelvic nodes (Type 2), we could not achieve better dose distributions with the SS method, namely in terms of OARs sparing and we were not able to take advantage of the reduced number of segments and MU, associated with the SS method.
No significant differences were found in terms of IMRT QA.

EP-1207
Influence of dose rate on dynamic IMRT plan quality and deliverability
S. Sharma[1], M. Durai[2], V. Subramani[1], B. Manoj[1], S. Aman[1], P.K. Julka[1], G.K. Rath[1]
[1]*All India Institute of Medical Sciences (AIIMS), Radiation Oncology, Delhi, India*
[2]*Sri Siddhivinayak Ganapati Cancer Hospital, Radiation Oncology, Sangli, India*

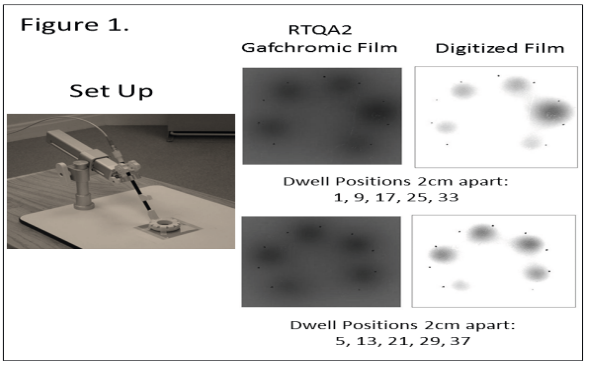
Purpose/Objective: Objective of the present work is to evaluate the influence of increase in dose rate on dynamic IMRT plan quality and deliverability.
Materials and Methods: Three previously treated patients of carcinoma prostate were chosen. Planning target volume (PTV) and organ at risk (OAR) i.e. bladder and rectum were contoured. Dynamic SIB-IMRT plans were created in Eclipse treatment planning system (TPS) for Varian CL2300C/D linear accelerator. Seven equi-spaced fields with 6MV photon beam at 300MU/min dose rate with 2.5cm/sec maximum allowable leaf velocity was used. The plan was then re-optimized by keeping all the parameters constant, only dose rate was varied as follows: 400MU/min, 500MU/min and 600MU/min. Therefore, for each patient, four different plans were created. Prescription dose was 74Gy for PTV primary(PTV-P) and 54Gy for PTV Nodal (PTV-N) in 27 fractions and dose was prescribed at 95% isodose line. Plan quality was analyzed by means maximum and mean doses of PTV and OAR. Normal tissue integral dose (N.T.I.D.) (liter-Gray) of normal tissue volume (i.e., patient volume minus PTV-P and PTV-PA) was also calculated. Dose rate of 300MU/min was taken as reference. For accuracy of deliverability, treatment plans were verified with I'matriXX ion-chamber array and compared with TPS dose-plane by using gamma (γ) index of 3% dose difference and 3mm distance to agreement (DTA) criteria. Percentage of pixels passing gamma value up to 1($\gamma_{\%} \leq 1$) were noted. In addition, total monitor units (MUs) required to deliver a plan and machine beam ON time (min) were also noted.
Results
Results are summarized in Table-1

PATIENT	Patient 1				Patient 2				Patient 3			
DOSE RATE RATIO	300/300	400/300	500/300	600/300	300/300	400/300	500/300	600/300	300/300	400/300	500/300	600/300
PTV-P MAX.	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.001	1.000
PTV-P MEAN	1.000	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.001
PTV-N MAX.	1.000	1.000	1.000	1.001	1.000	1.001	1.002	1.002	1.000	0.999	0.999	1.000
PTV-N MEAN	1.000	1.000	1.000	1.001	1.000	1.000	1.000	1.001	1.000	1.000	1.000	1.001
BLADDER MAX	1.000	1.000	1.000	1.001	1.000	0.999	1.000	1.000	1.000	1.000	1.000	1.000
BLADDER MEAN	1.000	1.000	1.002	1.003	1.000	1.001	1.002	1.003	1.000	1.001	1.003	1.005
RECTUM MAX	1.000	1.000	1.000	1.001	1.000	0.999	1.000	1.000	1.000	1.000	1.002	1.002
RECTUM MEAN	1.000	1.000	1.000	1.001	1.000	1.000	1.001	1.002	1.000	1.001	1.001	1.002
N .T. I. D.	1.000	1.003	1.006	1.009	1.000	1.003	1.006	1.009	1.000	1.002	1.005	1.007
PATIENT	Patient 1				Patient 2				Patient 3			
DOSE RATE	300	400	500	600	300	400	500	600	300	400	500	600
TOTAL MU	1565 MU	1931 MU	2024 MU	2112 MU	2254 MU	2337 MU	2426 MU	2513 MU	2322 MU	2389 MU	2468 MU	2552 MU
BEAM ON TIME	6.78 min.	5.35 min.	4.43 min.	4.01 min.	7.80 min.	6.25 min.	5.15 min.	4.28 min.	7.83 min.	6.18 min.	5.10 min.	4.45 min.
γ INDEX ($\gamma_{\%} \leq 1$)	98.97 %	99.11 %	98.95 %	99.02 %	99.78 %	99.87 %	99.56 %	99.68 %	99.48 %	99.39 %	99.44 %	99.44 %

Conclusions: There is no much dose difference was found for the PTV. However, slight difference was found for PTV-N maximum and mean doses. Similarly,increase in bladder mean dose, NTID and total number of MU increased with increase in dose rate. Beam ON time was lesser for higher dose rate. 2D gamma analysis showed almost comparable results for all dose rates.

EP-1208
Uncertainties in reconstructing ring applicators with gafchromic film for treatment planning of cervix patients
O. Awunor[1], B. Dixon[1], C. Walker[1]
[1]*The James Cook University Hospital, Radiotherapy Physics Department of Medical Physics, Middlesbrough, United Kingdom*

Purpose/Objective: In 3D image-guided HDR gynaecological brachytherapy treatments, a consequence of the small size of the ^{192}Ir sources that are used for treatment combined with a steep dose gradient is that precise determination of source dwell positions becomes critical for accurate reconstruction of ring applicators. In comparison to CT and MRI which only allow for indirect reconstruction of applicators and consequent increase in associated reconstruction uncertainty, the use of film enables direct reconstruction of source dwell positions. This paper details a methodology and associated uncertainties relating to the reconstruction of ring applicators using gafchromic film.
Materials and Methods: RTQA2 gafchromic films were attached to the surface of Nucletron interstitial ring applicators and irradiated at pre-programmed dwell positions 1 cm apart in the configuration shown in figure 1. Four, three and one sets of Ø26 mm, Ø30 mm, and Ø34 mm ring applicators respectively were used for this study. The irradiated films were digitized using an Epson Expression 10000XL scanner. The coordinates of the source dwell positions were identified and the source path for the rings characterized by investigating correlations between the source path and movement of the source cable. Measurements were repeated over a period of nine months using three consecutive ^{192}Ir sources and inter applicator and inter source dwell position differences investigated.



Results: The source path was observed to deviate from the cable path by up to 30% leading to a cumulative deviation in expected source dwell position of at least 5 mm in all ring applicators. The inter applicator and inter source differences in source dwell positions were observed to be within the associated measurement uncertainties for the Ø30 mm and Ø34 mm ring applicators. Significant differences were observed between sets of the Ø26 mm ring applicators. The total expanded uncertainties associated with the determination of source positions in the applicators and presented in table 1, showed a maximum intra applicator average total expanded uncertainty (k=2) of 1.14 ± 0.30 mm, 1.19 ± 0.14 mm and 1.04 ± 0.30 mm for the Ø26 mm, Ø30 mm and Ø34 mm ring applicator sets respectively. The inter applicator average total expanded unceratinty was also observed to be 1.07 ± 0.11 mm and 1.09 ±0.05 mm for the Ø26 mm and Ø30 mm ring applicators.